Lao-Thai Technical Conference on Geology & Mineral Resources

Hydrocarbon Potential of Champasak & Saravan area, Southern Lao PDR

Vientiane, 01/2013
Content

1. Introduction

2. Regional Geology

3. Hydrocarbon Potential of C&S area

4. Conclusion and Discussion
PVEP OVERSEAS Project Overview
Location: Champasak & Saravan province, Southern Laos
Area: 14,140 km²
PSC: Signed on 08/01/2008
Participate interest: PVEP: 80%-Operator; Salamander: 20%
**Hunt Oil (Previous operator, 1990-2000):**

- Surveyed 9,159 km aeromagnetic and 7,205 km line gravity.
- Drilled Pakse-1 well in 1997, TD @ 2540m, dry well

**PVEP (current operator, from 2008):**

- 500 km 2D seismic – 22 lines (2010-2011)
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Regional Tectonic Elements

- The Proto-Indosinia domain with the Paleozoic boundary (Late Devonian) controlled in the west by the Nan-Uttaradit - Sra Keo suture;

- Accretionary Mesozoic domain (the Indosinian folded belt);

- The Sibumasu domain bounded easterly by the Chiang Mai – Bengton-Raub suture;
Geological setting

- The Western part of Khorat basin lays on late Paleozoic-early Mesozoic Loei-Phetchabun thrust fold belt;

- The Southern part is bounded by the C₃-P₁ XiemRiep-Daklin pluton volcanic arc;

- The Northeast part is separated by the Truong Son fold belt;

- The Southeast part lays on the Xe Kong early Paleozoic fold belt with overlaid coverage of C-P clastic-carbonate, T₁₂ clastic-volcanic sediments and T₃ⁿ coal-bearing clastic rocks.
### Stratigraphy & Hypothetical Hydrocarbon system

<table>
<thead>
<tr>
<th>CHRONOSTRATIGRAPHY</th>
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<td>Basement</td>
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**Major Tectonic event**
- Himalayan Orogeny
- Regional Subsidence
- Indosinian III
- Indosinian II
- Indosinian I
- Mid Carboniferous Orogeny

**Res** | **Seal** | **Source**
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HC OCCURRENCES

- **Phu Horn Field**
  - DST: 4MMscfd (Carbonate Pemci, Sandstone Trias).
  - 2P:~ 500BCF (Salamander, 2007)

- **Well Chonnabot-1/Phu Wiang-1**
  - Good gas show of sandstone Trias; DST: small flow
  - Gas kick while drilling of Carbonate C31-P31, DST no flow

- **Well Dong Mun-1**
  - Discovered gas in carb. Reef, DST: 4 MMscfd

- **Well Si That-2**
  - Discovery, DST: 1.5 MMscfd, carbonate Pemci reservoir

- **Well Mukdahan-1**
  - Gas show in sandstone Trias, DST: 0.07 MMscfd.

- **Nam Phong Field**
  - DST: 30 MMscfd (Carbonate Pemci)
  - 2P:~ 450BCF; (KT: 100 MMcfgd)

- **Well Non Sung-1**
  - Drilled to Sandstone, Carob. Pemci, Gas show, no DST

- **Well BangNouan-1X**
  - Gas show in Sandstone Trias.

- **Bang Nouan 1**
  - Gas show in Sandstone Trias.

- **Pakse-1X**
  - Lô Savannakhet

Khorat basin covered NE Thailand & Central Southern Lao, with area ~200,000km².

- Main targets: Permian fractured carbonate & Triassic Sandstone.

- Drilled 22 exploration well. Encountered carbonate target in 11 wells; flows in 5 wells; commercial flow in 2 wells

- Nam Phong gas field (2P: ~500BCF) in production ~ 100 MMscfd & Phu Horn (2P: ~500BCF);
Hydrocarbon System Evaluation

1. Source Rock
2. Reservoir Rock
3. Seal Rock
4. Play Type
Potential Source Rocks

- Late Carboniferous coal, coaly mudstone and Permian marine lime-mudstone

- Late Triassic lacustrine mudstones
Exceeding 100 m thick of medium- to thin bedded intense fractured limestones, interbeds of dark grey claystone.
## Geochemistry Analysis

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Potential Reservoir Rocks

- Middle Permian Carbonate
- Late Triassic sandstones
Over 100m of thick to medium bedded limestones, bed orientation 130@60;

- Vuggy, karstic, fractured, locally dolomitised limestone

- Formamilifera fossils: *Pseudofusulina* sp., *Schubertella* sp., *Globivalvulina* sp – indicating Early Permian age (Sakmari – Artinski).
Packstone with abundant amount of bioclast fragments of mainly *Fusulinid Foraminifera* (F), *Coral* (C), *Oligostegina microfossils* (fine elliptic) and unidentified others. Most fossils are poorly preserved because most their chambers and walls are partly or completely occluded by micrite and fine crystals of calcite or dolomite. Minor visible porosity.
Petrographic Analysis

Triassic sandstone:

- Lithic arkose – Arkose sandstone, fine grained; subangular and ubround to round grain shape;
- Moderately to strongly compacted with mainly long and concavo-convex to suture grain contacts.
- Authigenic clay minerals partly filled intergranular pores.
- The visible porosity is minor negligible (<10%).

[Geological Map
Xekong-Saravan Area
1:100 000
(Using satellite Images & field data)]
Geological Section from Bang Nouan to C&S Area
Potential Seal Rocks

- Upper Permian and Late Triassic shales

- Early-Middle Jurassic marine shales
Potential Seal

Thick marine shale sequence observed play as regional top seal for Triassic sandstones
Play Type
Play Type

Phu Horm gas field

Reservoir
- Permian platform carbonates
- Massive/fractured
- Partially dolomitised
- Triassic sandstones in faulted/folded anticlines.

S2 Prospect
Conclusion & Discussion

- Existence of potential prospect in the area confirmed based on surface geology study & seismic interpretation results
- Area of complicated geology, multi-phase intensely tectonized with various structural deformational types
- Area inherited HC exploration challenges for the area. Further extensive investigations is highly recommended to clarify inherited risks of the area.
THANKS FOR ATTENTION!